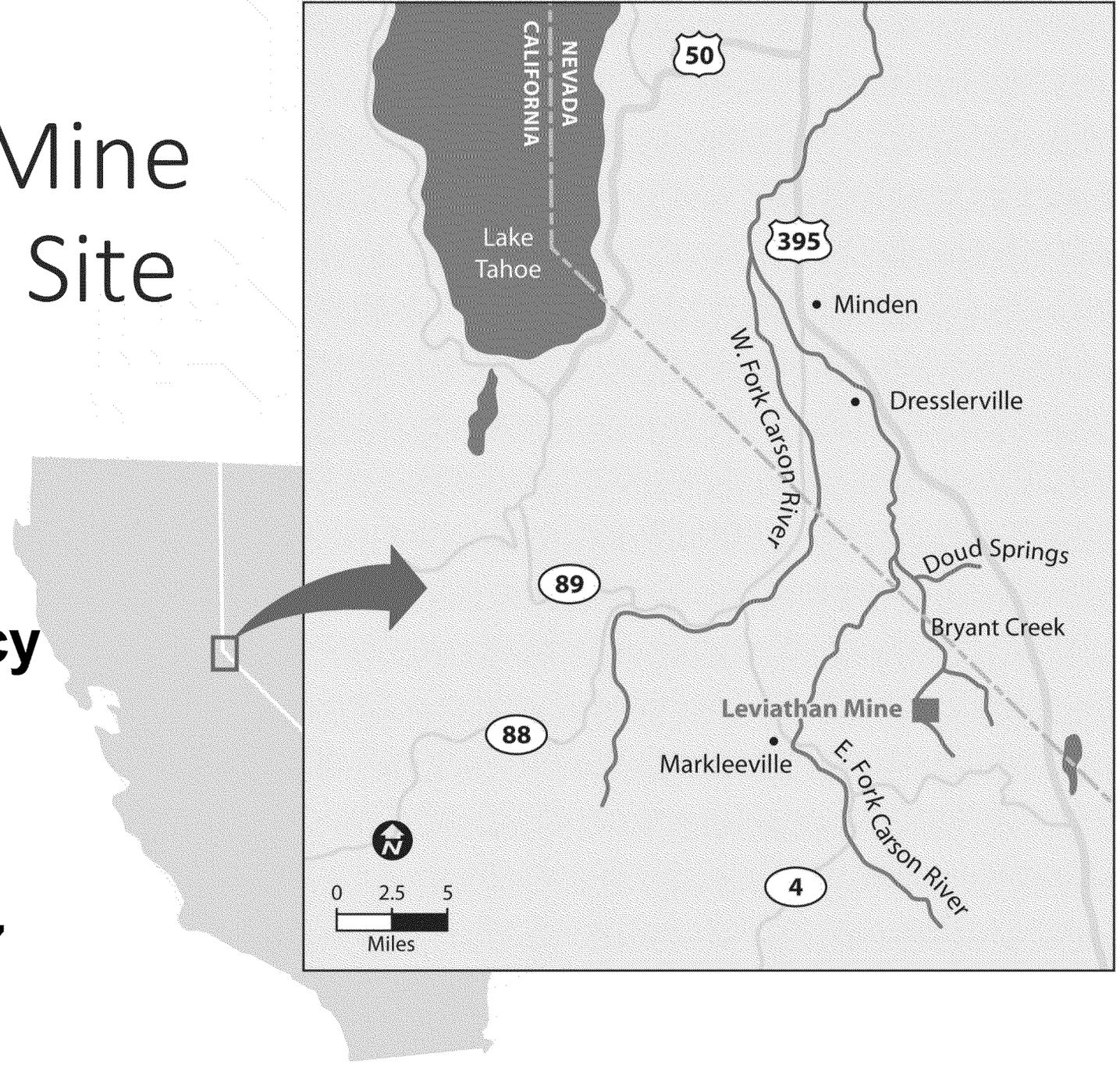
Leviathan Mine Superfund Site

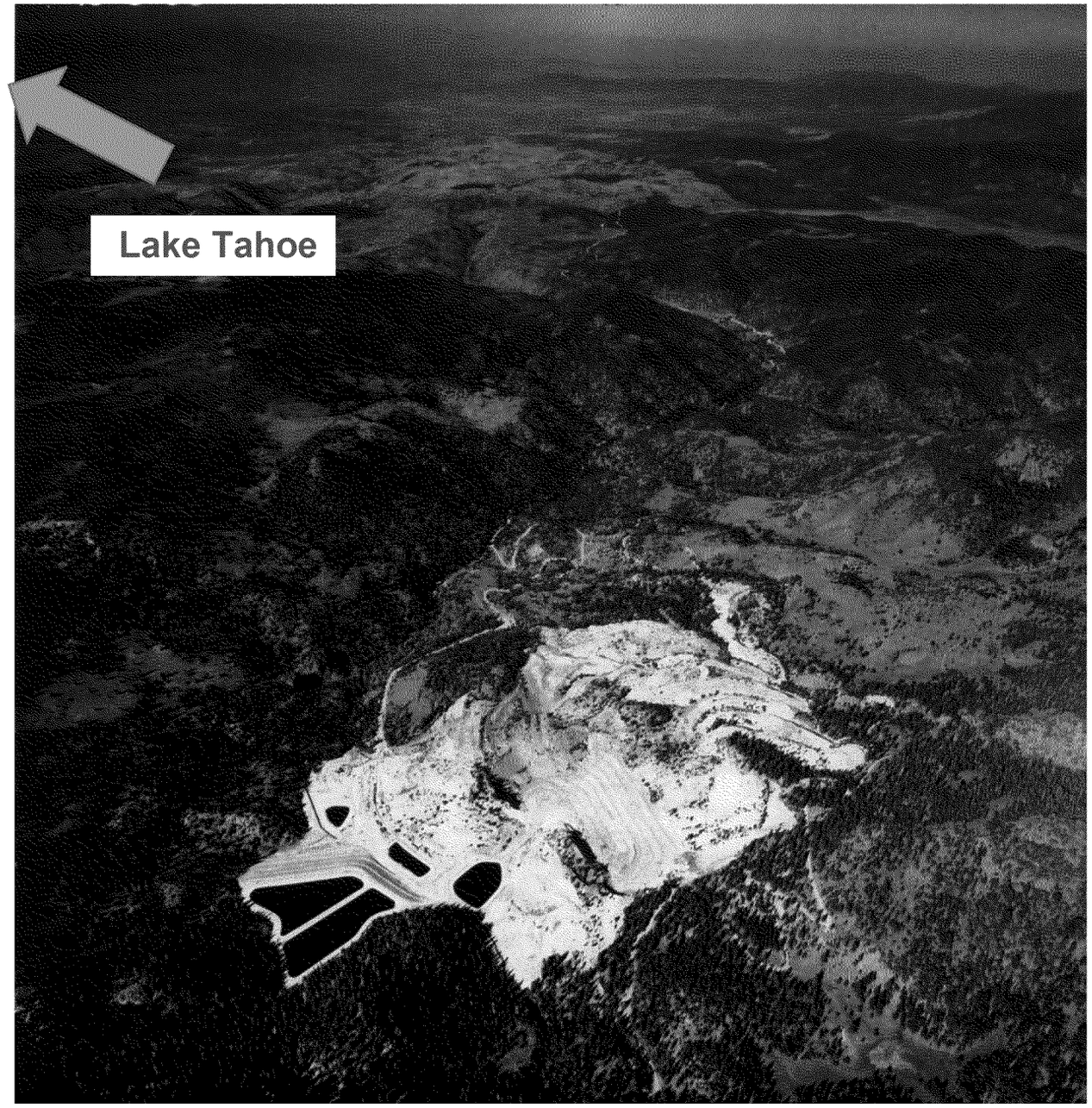
U.S. Environmental Protection Agency Region 9

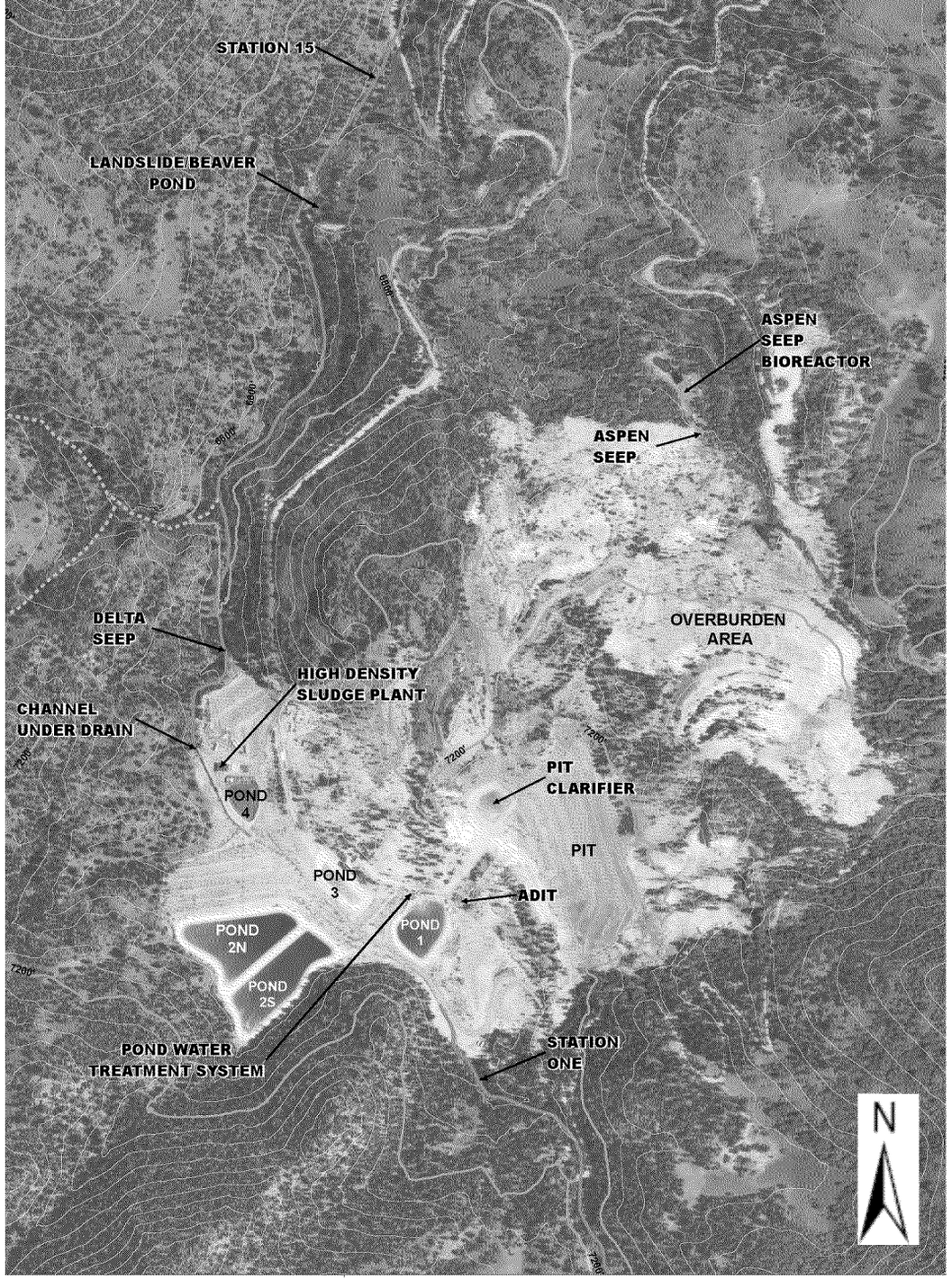
March 2017



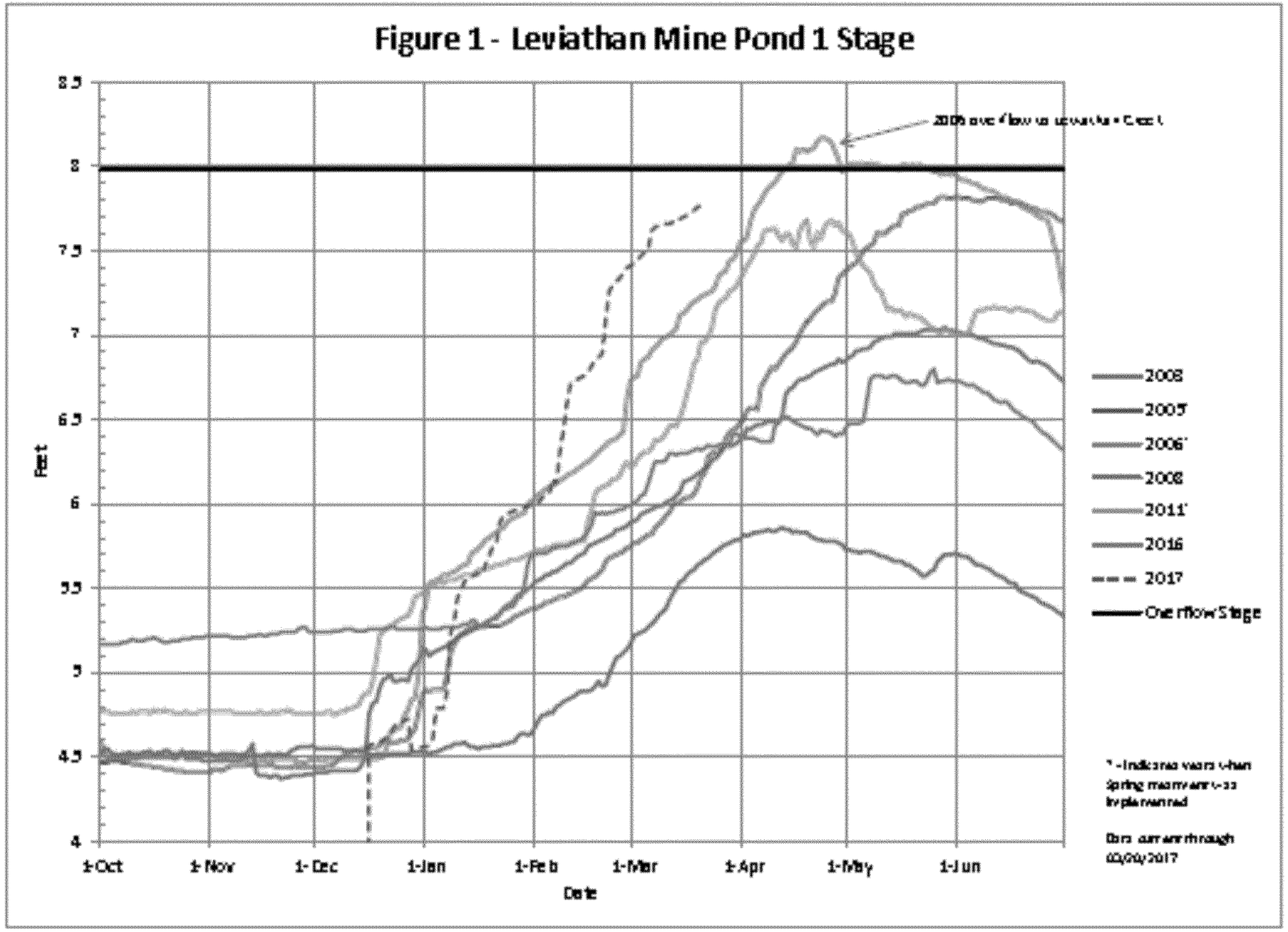
Leviathan Mine Alpine County, CA

- Abandoned open-pit sulfur mine. Listed on NPL 2000
- 24 Miles Southeast of Lake Tahoe
- Flows Northeast, to EFCR
- Impacts ~250 acres On site, ~750 acres Off site
- High elevation, inaccessible in winter
- Upstream from national forest, private, and Washoe land
- Interim Actions 80's;& Removal Actions still in place
- Remedial Investigation Ordered in 2008





- Since 2001, most AMD captured and treated before discharge to Leviathan Creek during summer
- This annual seasonal treatment significantly improved downstream water quality in Leviathan Creek
- The HDS plant does not captureAMD during the winter time.
- Storage Ponds collect water during the winter. However, overflow/ discharge did occur in 2005, 2006, and 2011
- Early Spring Treatment using a similar portable process was initiated in March 3, 2011



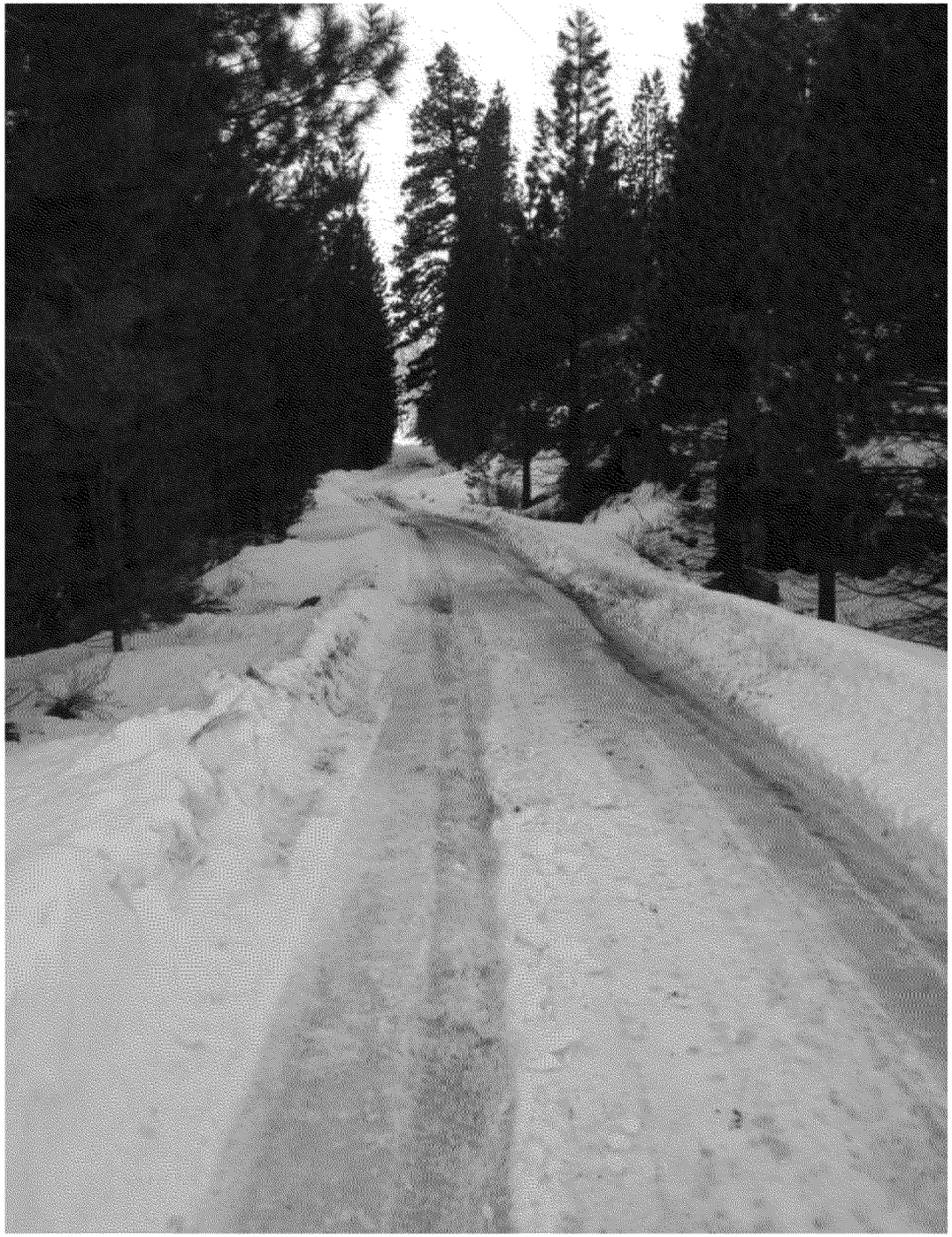


Photo 1 – Erosion on USFS Road 31032 due to storm water runoff

Photo 3 – TKT neutralizing AMD in Pond 3 with the RCTS shortly before discharge

Photo 5 – Discharge of treated water from Pond 3 to Leviathan Creek via the overflow structure. Treated water was pumped from below the ice layer.

Table 1
2017 Spring Treatment, Leviathan Mine
Pond 3 Estimated Discharge Volume

Date	Estimated Discharge Volume (gallons)
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Total Spring Treatment Discharge Volume [illegible]

Table 2
2017 Spring Treatment, Leviathan Mine
Untreated Pond Water Sample Results

SAMPLE ID	Sample Description	SAMPLE Date	pH	TEMP (°C)	Aluminum	Arsenic	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Sulfate (as SO4)	Total Dissolved Solids	Zinc
USEPA Daily Maximum Discharge Criteria			[illegible]		[illegible]	[illegible]	[illegible]	NP	[illegible]	NP	[illegible]	[illegible]	[illegible]	NP	NP	[illegible]	NP	NP	NP	[illegible]
USEPA 4-Day Average Discharge Criteria			NP		[illegible]	[illegible]	[illegible]	NP	[illegible]	NP	[illegible]	[illegible]	[illegible]	NP	NP	[illegible]	[illegible]	NP	NP	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]																

Table 3
2017 Spring Treatment, Leviathan Mine
Pond 3 Discharge Sample Results

SAMPLE ID	Sample Description	SAMPLE Date	pH	TEMP (°C)	Aluminum	Arsenic	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Selenium	Sulfate (as SO4)	Total Dissolved Solids	Zinc
USEPA Daily Maximum Discharge Criteria			[illegible]		[illegible]	[illegible]	[illegible]	NP	[illegible]	NP	[illegible]	[illegible]	[illegible]	NP	NP	[illegible]	NP	NP	NP	[illegible]
USEPA 4-Day Average Discharge Criteria			NP		[illegible]	[illegible]	[illegible]	NP	[illegible]	NP	[illegible]	[illegible]	[illegible]	NP	NP	[illegible]	[illegible]	NP	NP	[illegible]
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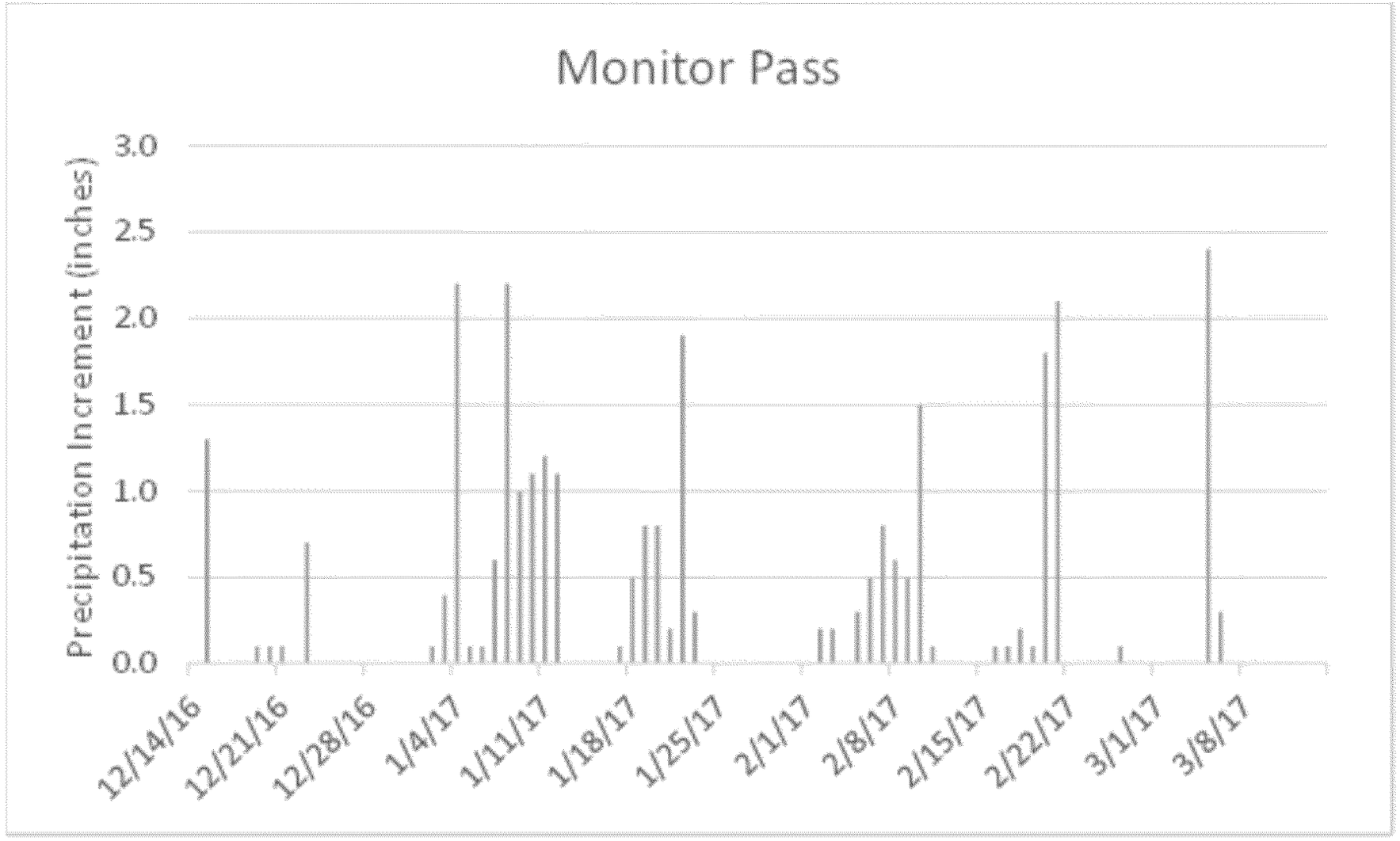
Precipitation Mid-December through Mid-March

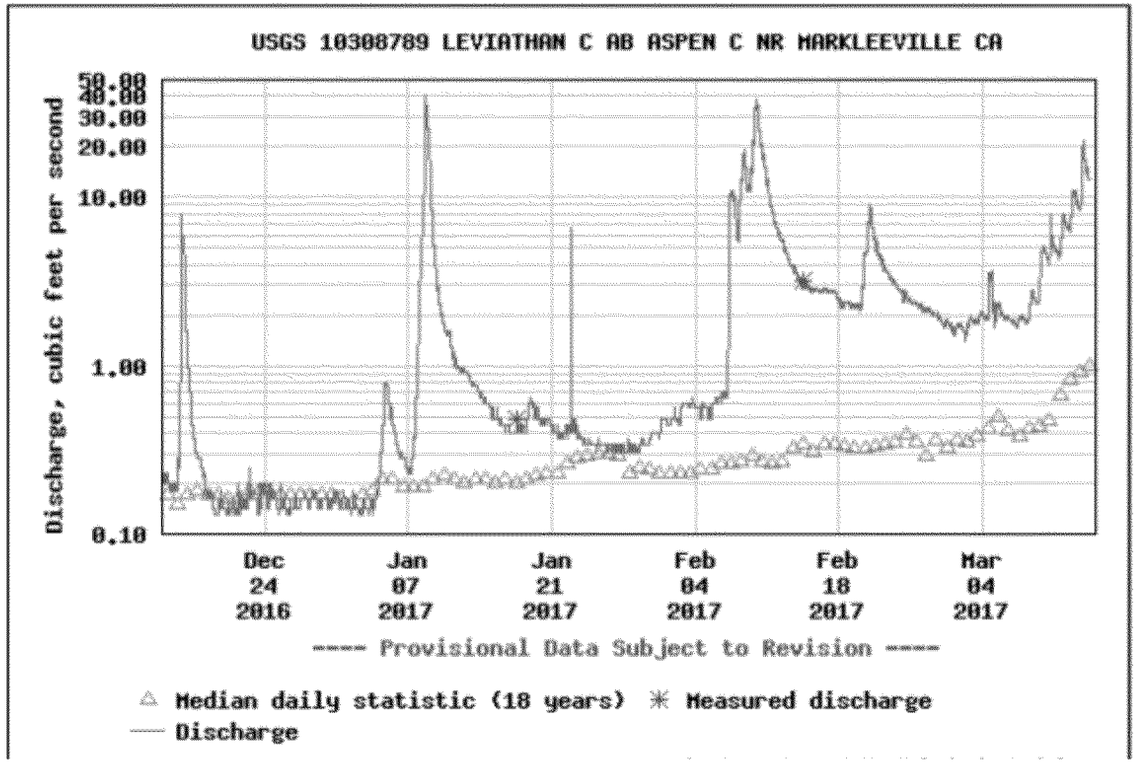
Precipitation measured by the Monitor Pass SNOTEL station for the last three months (December 13, 2016 – March 13, 2014) shows that daily incremental precipitation exceeded 1 inch on 12 days. The highest daily incremental precipitation, 2.4 inches, occurred on March 5.



Streamflow and Water Quality Mid-December through Mid-March

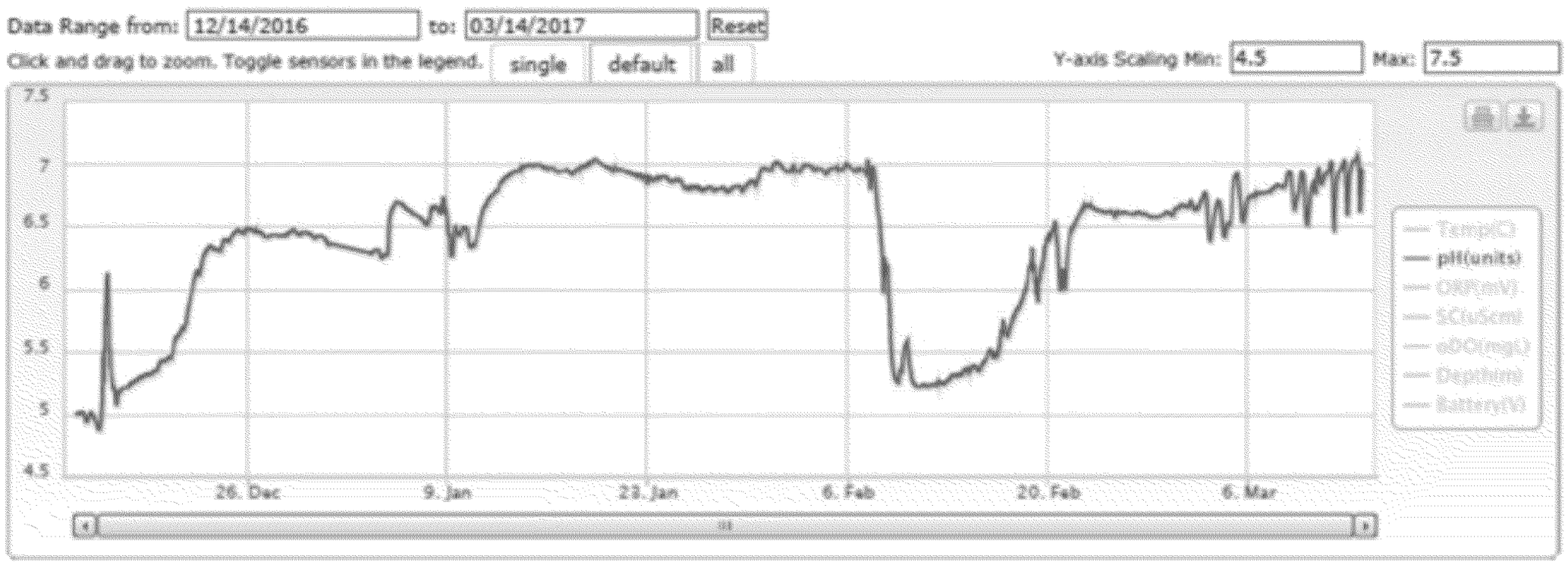
Streamflow in Leviathan Creek is measured at Station 15, the USGS gaging station downstream of the beaver dam/pond complex but upstream of the confluence with Aspen Creek. Periods of elevated streamflow generally followed precipitation events, but streamflow is not proportional to precipitation. Precipitation can fall as rain or snow. Rain, particularly rain on snow, causes greater streamflow than does snow. Streamflow can also be produced by snowmelt during periods of no precipitation. The most recent period in which streamflow increased from about 2 cfs to about 20 cfs appears to be caused by snowmelt. Precipitation was not measured at Monitor Pass March 7-13, yet streamflow increased throughout this period, reaching a maximum value of 21 cfs on March 13. There is also a diurnal pattern with streamflow generally increasing during the day and declining during the night, which is characteristic of snowmelt. Although treated pond water may have been discharged in late February or early March, the discharge would be small relative to the total measured flowrate. As a point of reference, 100 gallons per minute is approximately 0.2 cfs.

The measured streamflow was greater that the median flowrate throughout most of this period.



The February 9-10 38 cfs (17,000) peak is the third largest flow event recorded at this site. The largest flow, 68 cfs (30,500 gpm) was measured December 31, 2006, and the second, 40 cfs (18,000 gpm), was measured January 8, 2017. Other relatively large flowrates >20 cfs occurred in 1999, 2010, 2011, and 2016.

pH variations during this period are more complicated than the SC variations. During mid-December, pH gradually increased from about 5 to 6.5 standard units and had a short term increase to about 6.1 associated with the December flow event during this gradual increase. pH was relatively stable at approximately 6.3 to 6.5 until the flow event the week of December 31. During the flow events that occurred the weeks of December 31 and January 7, pH increased from about 6.3 to 6.7, and then declined and fluctuated between about 6.3 and 6.5. pH increased from about 6.3 on January 11 to 7.0 on January 14 and remained fairly constant at 6.8 to 7.0 until February 7, then declined to about 5.3 on February 9 during a high flow event, increased to approximately 6.5 on February, and fluctuated between 6.4 and 7.0 through March 13.



Photograph 6: Leviathan Creek Culvert Looking Downstream

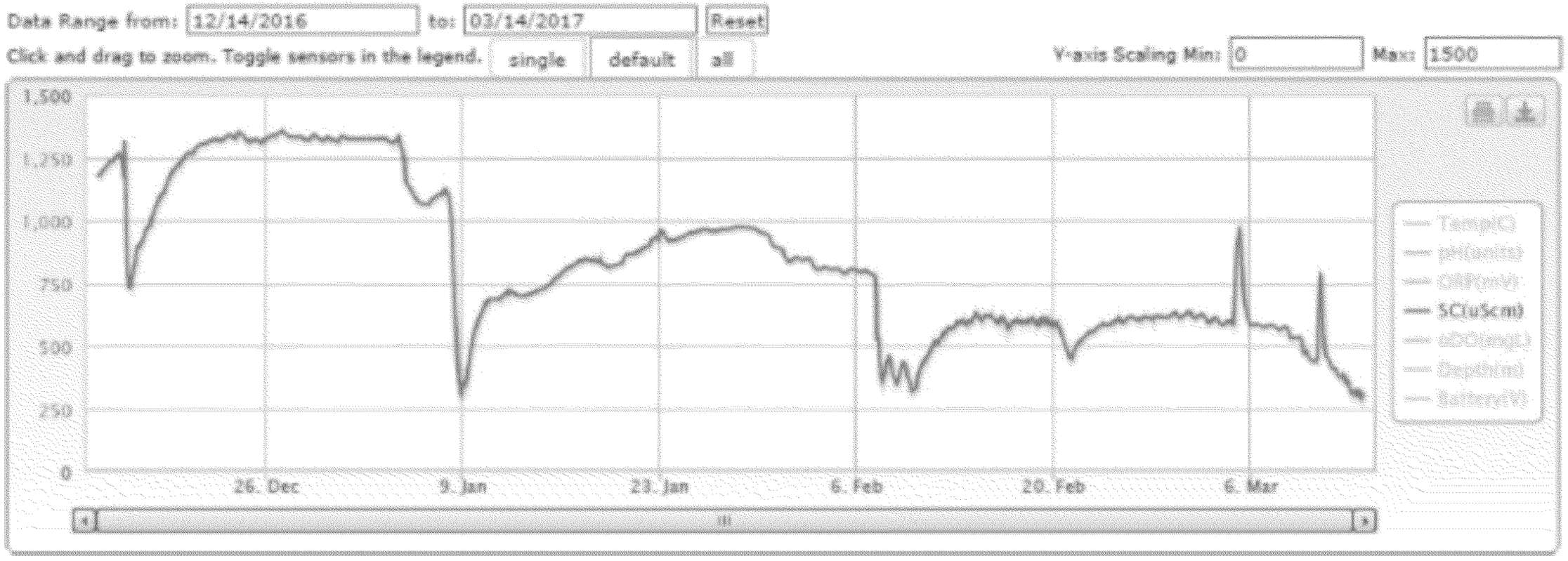
Contingency and Monitoring Plan

Both ARC and Waterboard conduct a monthly site visit. During each event, field observations indicated that adequate pond storage was available, and there was no indication of beaver dam failure or restriction of the Leviathan Creek Culvert.

	ARC visits	RWQCB Visits
	December 2, 2016 January 6, 2017 February 1, 2017 March 2017, TBC	January 17, 2017 February 14 , 2017 February 26, 2017 March or early April, 2017 TBC

Water Quality

Water quality parameters specific conductance (SC) and pH (as well as other parameters) are measured by U.S. EPA's water quality monitor adjacent to the streamflow station. SC declined abruptly during periods of high streamflow, and was relatively stable between high flow events. The cause of the short term spikes in SC March 5 and March 10 has not been identified.



ARC Oversight Early Response Actions

	Aspen Seep Bioreactor	HDS Plant
	Increase in flow through the ASB Treatment System; higher flows are expected during most of 2017 --More consumables (Ethanol, NaOH, and propane) --Remote monitoring adjust chemical dosing for changing flow rates --Access via snowmobiles --Increased flows do not appear to affecting operating effectiveness. --Continue to monitor for system effectiveness	HDS does not operate during the winter months --Increased flow rates of CUD and DS --Higher than average initial volume of Pond 4 ---Increased use of consumables (lime, flocculant, diesel, fresh water). --Site access/ treatment season could be limited

EPA Contact Information

EPA's Superfund Toll-Free telephone number 1-800-231-3075

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EPA's Web page: www.epa.gov/region09/LeviathanMineSite

Information Repositories

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